Report as of FY2009 for 2009MT195B: "Student Fellowship: A More Efficient Micro-hydro that Utilizes a Tesla Turbine Technology"

Publications

Project 2009MT195B has resulted in no reported publications as of FY2009.

Report Follows

Summary of “Building a Tesla Turbine”: Alaina Garcia, Mechanical Engineering, MSU

The present Tesla turbine prototype is not a copy of the original Tesla unit, but uses the same principals, spins on compressed air and probably would produce more torque on steam versus water. This is one of the biggest learning concepts of the project thus far. Yet one of the great things about the Tesla turbine is its simplicity. To make the turbine run, high-pressure fluid enters the nozzle at the outer chamber stator inlet. The fluid passes parallel between the rotor disks and causes the rotor to spin using boundary-layer adhesion from the fluid’s viscosity. Eventually, the fluid exits through the exhaust ports in the center of the turbine and two aluminum cuffs hold the disks in position on the shaft. As the disks will be (come spring semester) keyed to the shaft, their rotation is transferred directly to the shaft. The rotor assembly is housed within a cast acrylic stator and the axis is the only moving part. The prototype has 8 disks (computer hard drives), 4 inches in diameter, spaced at .004 inches, and develops speeds of 4,000 RPM (measured using a tachometer in Norm’s physics machine shop at MSU) using compressed air from a machine shop. One of the design changes for the next semester will allow the shaft to have a lower coefficient of friction and higher rpm by aluminum lining the aluminum axis shaft so it is not spinning on cast acrylic.

In Tesla's final attempt to commercialize his invention in 1910, he persuaded the Allis-Chalmers Manufacturing Company in Milwaukee to build three turbines. Two had 20 disks, 18 inches in diameter, and developed speeds of 12,000 and 10,000 rpm respectively. The third had 15 disks, 60 inches in diameter and was designed to operate at 3,600 rpm; generating 675 horsepower. Tesla's original design called for two inlets, which allowed the turbine to run either clockwise or counterclockwise. During the tests, engineers from Allis-Chalmers grew concerned about the mechanical efficiency of the turbines, as well as their ability to endure prolonged use. They found the disks distorted to a great extent and concluded the turbine would have eventually failed. This, more than anything, prevented the Tesla turbine from becoming widely used. Nowadays, composites such as carbon-fiber, titanium-impregnated plastic and Kevlar-reinforced disks could prove to be more qualified materials.

Spring research will continue to vary the size and number of the disks. Tesla's patent paperwork doesn't define a specific number, but uses a more general description, stating the rotor should contain a "plurality" of disks with a "suitable diameter and spacing." Tesla-type turbomachinery probably cannot prove competitive as an application in which more conventional machines have adequate efficiency and performance. Tesla turbine applications are for small shaft power, or the use of very viscous fluids, or of non-Newtonian fluids. For that reason they should be further investigated for applications to produce power from geothermal steam and particle-laden industrial gas flows. There is considerable evidence that multiple disk turbomachinery can operate quieter and to resist fluid cavitation that is specifically avoided in the design of machines such as turbines or propellers.

Finally, I would like to say “Thanks!” to the Montana Water Center and Robb Larson for the opportunity to do the research and design of a Tesla turbine! It has been a very interesting learning experience. With the assistance of the Undergraduate Scholars Program, I will continue work on a prototype that will spin (speed is yet to be determined) with water from a stream and function as a micro-hydro unit with the assistance of an alternator.